Prof. Dr. Susanne Crewell
University of Cologne, Germany

TRAINING FOR ATMOSPHERIC REMOTE SENSING: THE ITARS PROGRAM

BRUSSELS, BELGIUM
13-15 OCTOBER, 2015

ITaRS
Initial Training for atmospheric Remote Sensing

PEOPLE
MARIE CURIE ACTIONS

Content

ITaRS
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- Why ITaRS?
- ITaRS in a nutshell
- Training of a new generation
  - Recruitment
  - Network activities
- Scientific results
  - Aerosols
  - Clouds
  - Weather and Climate

Please visit us at booth **3150**

http://itars.uni-koeln.de/

Why ITaRS?

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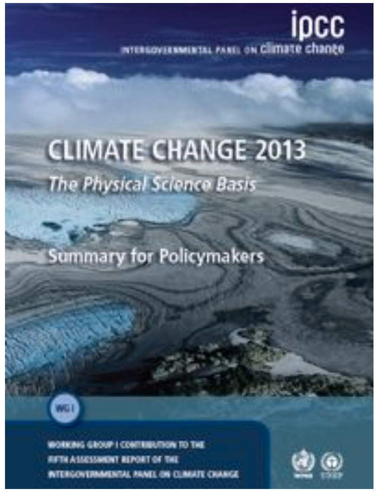
- International Panel on Climate Change (IPCC, AR5)
  *"There is high confidence that **aerosols and their interactions with clouds**s have offset a substantial portion of global mean forcing from well-mixed greenhouse gases. They continue to contribute **the largest uncertainty** to the total RF estimate."*



- Current observational system is **lacking sufficient observations** to better understand aerosols, clouds and their interaction both for climate prediction and weather forecasting.

- It took decades to bring individual instruments from the lab to the field for continuous measurements
  ➔ Now ist time to exploit the **synergy of remote sensing instruments** at Supersites and to demonstrate the usefulness for atmospheric research

Why ITaRS?

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Scientific Goals

- to bring together experts from the aerosol and cloud community to efficiently tackle the problems of **aerosol-cloud interaction** as well as their relevance for **climate and weather**
- to assess the **potential of advanced remote-sensing instrumentation** and capabilities as an ingredient in a future observation system based on both ground-based networks and space-borne observations
- to build close ties between **industry and research** to optimize instrumentation for future networks
- to speed up technological transfer from research to industry by direct **involvement of the private sector** in specific training & research programmes, secondments and joint patents

ITaRS in a Nutshell

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Project

- FP7-PEOPLE-2011-ITN, Initial Training Network
- 4 years **1 April 2012** to **31 March 2016**

Consortium

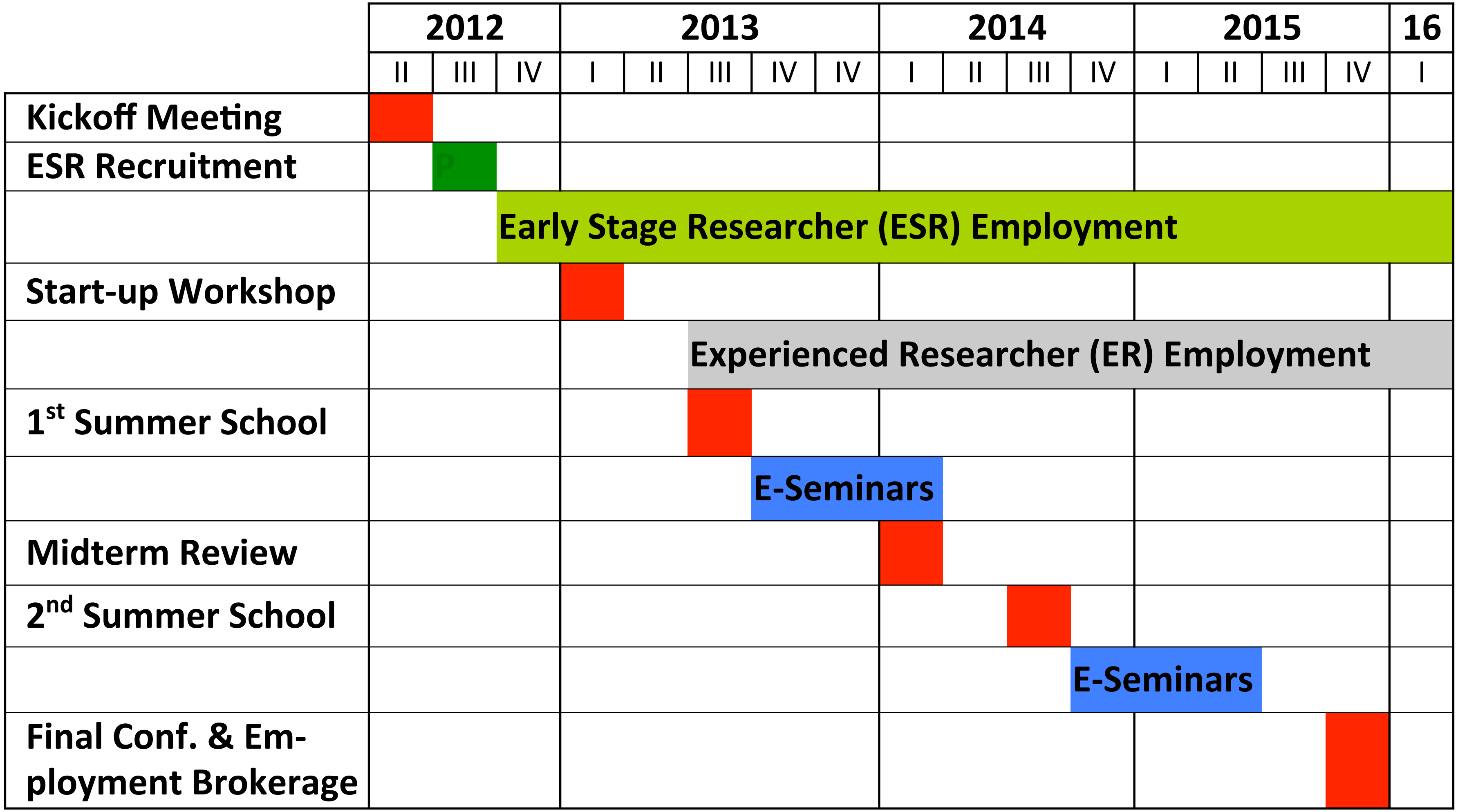
- 9 academic partner institutions in 7 European countries
- 5 associated partners from industry

➔ 5 additional associate partners

Fellows

- 11 Early Stage Researchers (ESR)
- 4 Experienced Researchers (ER)

Timeline


2012
2013
2014
2015
16
II III IV I II III IV IV I II III IV I II III IV I
Kickoff Meeting
ESR Recruitment
Early Stage Researcher (ESR) Employment
Start-up Workshop
Experienced Researcher (ER) Employment
1st Summer School
E-Seminars
Midterm Review
2nd Summer School
E-Seminars
Final Conf. & Em-ployment Brokerage

ITaRS Partnership

Initial Training for atmospheric Remote Sensing

- CNR-IMAA (Amodeo)
- INOE (Nicolae)
- RAY (Georgoussis)
- CIMEL (Victori)
- UP (Böckmann)

Aerosols

- UCO (Crewell)
- NTUA (Papayannis)
- RPG (Czekala)
- SELEX (Schäfer)
- UPC (Baldesano/ Rocadenbosch)

Climate and Weather

- TUD (Russchenberg)
- TROPOS (Wandinger)
- METEK (Bauer)
- UREAD (Chiu)

Clouds

INSTRUMENTS → ALGORITHMS → PHYSICS

Scientific Network

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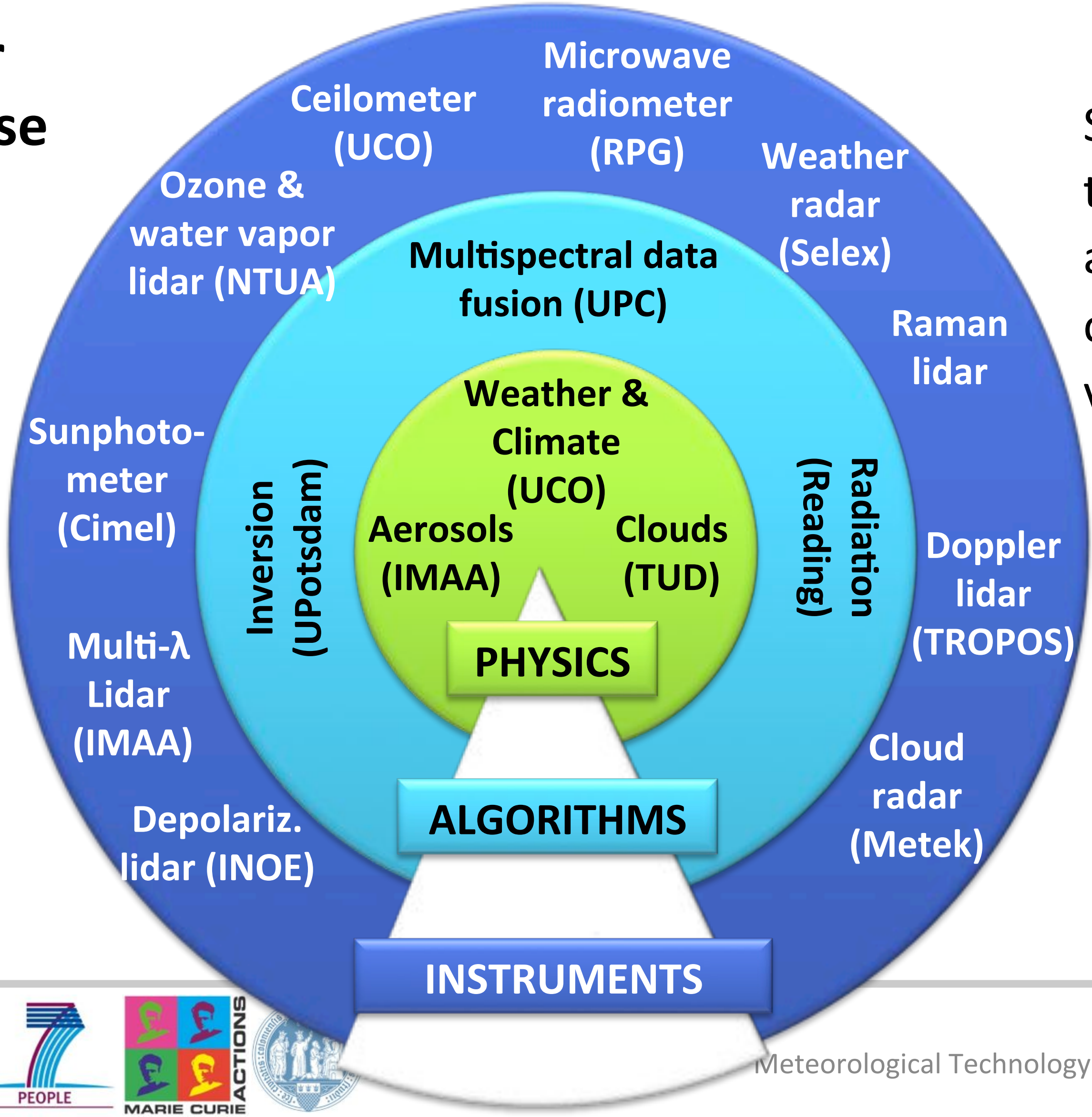
Partner Expertise



Several of the PhD topics are interlinked and mutual effective collaboration occurs via secondments

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Next Generation

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Training Objectives

- to impart an **in-depth understanding** of instrumentation and algorithms needed to retrieve geophysical quantities and atmospheric applications,
  ➔ **strong interdisciplinary training**
- to foster the **synergy of different sensors** by bringing together experts from the individual techniques
- to develop and implement **pan-European courses** on atmospheric remote sensing by exploiting new web-based techniques
- to close the gap between the specialized development of single instruments and atmospheric applications by training a new generation of scientists in **academia and the private sector**

Recruitment of Fellows

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- >140 application received for 11 ESR positions
- Centralized ESR selection days along international conference
- 22 candidates invited to ESR selection days at L'Aquila in Sep 2012
- Structured interviews to assess all relevant competences of the candidates
- Two-stage selection procedure for ER (skype + personal interview)

Network: 11 ESR, 4 ER, 1 "Associated ER", 40% female fellows, 10-11 different countries

Research Training Programme

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ESR & ER and Supervison Team

Individual Career Development Plan

Individual Training

S&T Training
- Individual research
- Courses at host
- Secondments
  - private sector
  - research & academia

Complementary Training
- Mentoring/coaching
- Project management & grant writing
- Language classes

Network Training

S&T Training
- E-Seminar
- E-Tutorials &Virtual Library
- Summer Schools

Complementary Training
- Communication skills
- Entrepeneurship
- Ethics & IPR
- Outreach

Network Training Events

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Introduction at Start-up Workshop, Athens, 02/ 2013

Fellows Meeting and participation in HOPE campaign 04/2013

Project work during summer schools

Highlights 1st Summer School

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Aerosol Remote Sensing, Processes & Applications

September 23 - October 4, 2013 in Bucharest

Lidar, Raymetrics

Visiting Researcher & External Lecturers

- Nico Cimini, IMAA
- Volker Freudenthaler, LMU Munich
- Detlef Müller, University of Herfortshire
- Athanasios Nenes, Georgia Tech

External Advisory Board

- Carla Cardinali, ECMWF
- Tammy Weckworth, NCAR
- Slobodon Nickovic, WMO

Summer schools to continue..

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2nd Summer School, September 2014, Jülich Germany
„**Clouds and Precipitation: Observation and Processes**“

1st ARM Summer Training & Science Applications event on observations and modeling of aerosol, clouds, and precipitation Oklahoma, July 15-24, 2015.

Research Training Programme

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E-Learning

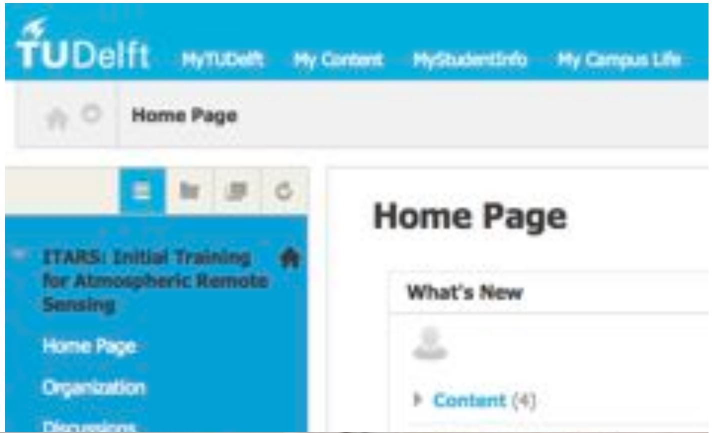
- Learning Platform Blackboard (online tutorials, forum, wiki pages)
- weekly E-seminars

Complementary Training

- Good Scientific Practice
- PhD Coaching, Scientific writing
- Science Communication

Outreach

- Wiki page instrument descriptions
- engage young students, MOOC...



Fellow's Secondments (2 weeks+)

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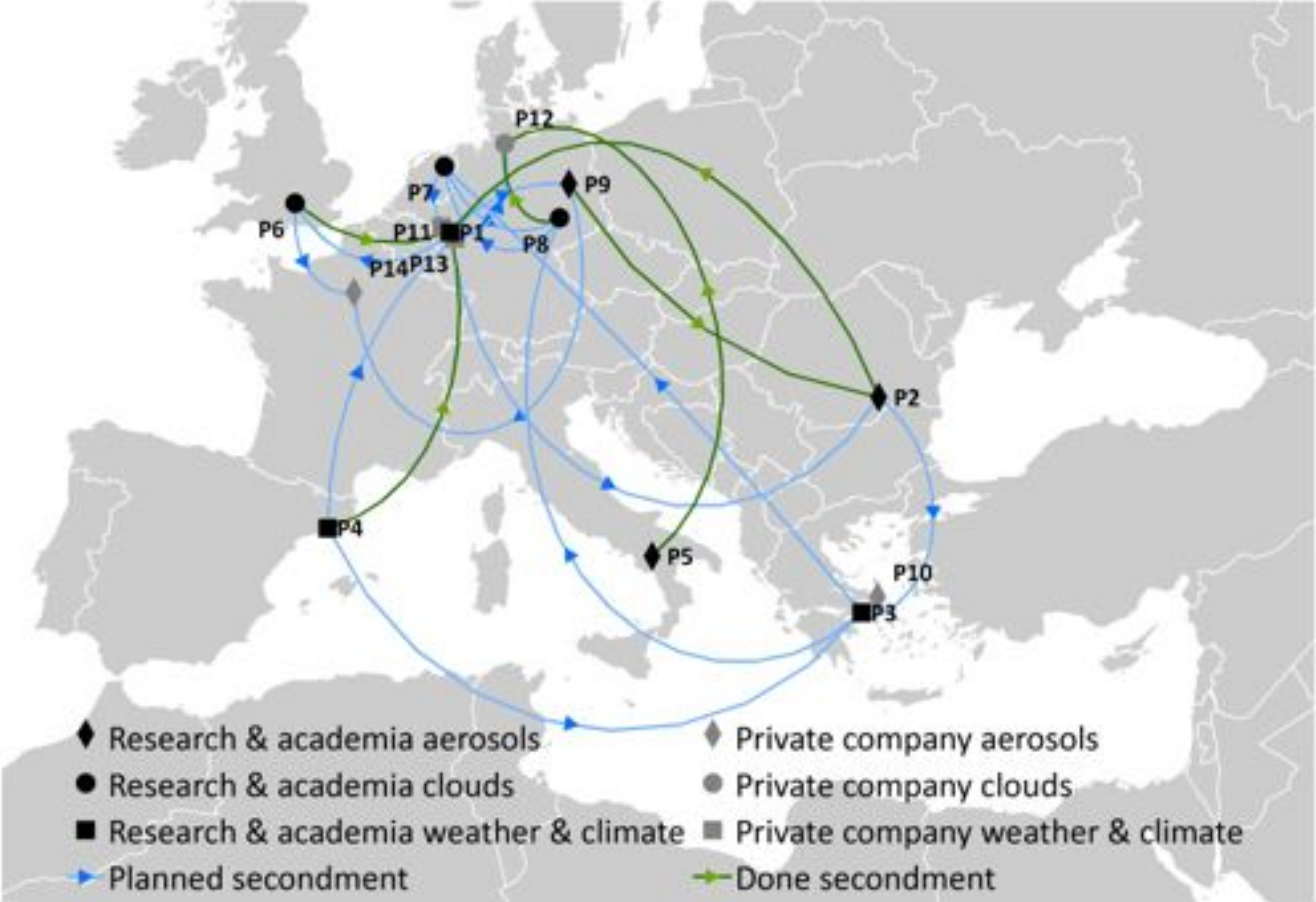

ITaRS Partnership

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Clouds

INSTRUMENTS → ALGORITHMS → PHYSICS

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Scientific Results

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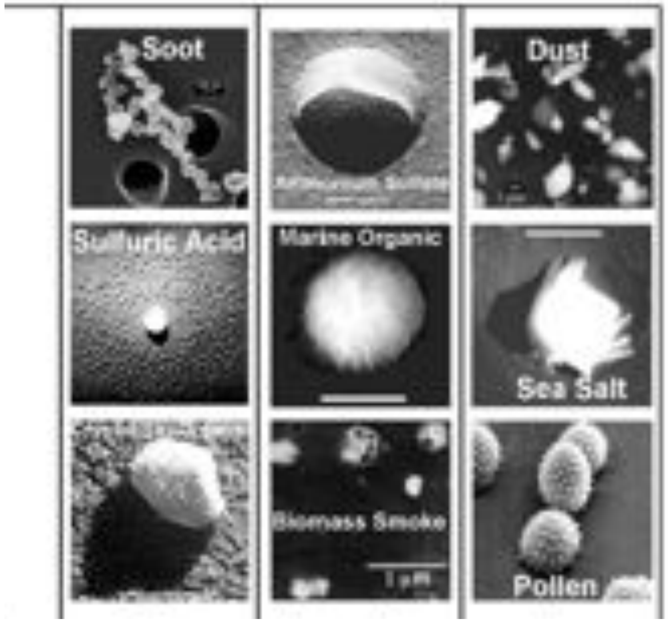
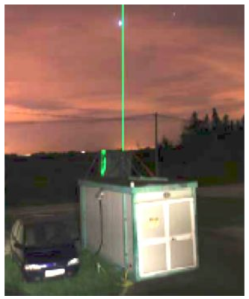
- Lev Labzovsky (INOE)
- Umar Saeed (UPC)
- Pilar Guma (IMAA)
- Stefanos Samaras (UPotsd.)
- Dr. Ioannis Binetoglou (INOE)

Aerosol



Lidar



Microwave Radiometer

Cloud Radar

Sun Photo-meter

- atmospheric boundary layer
- humidity effects
- aerosol properties
- mathematical retrievals
- dust transport

Aerosol: Humidity effects

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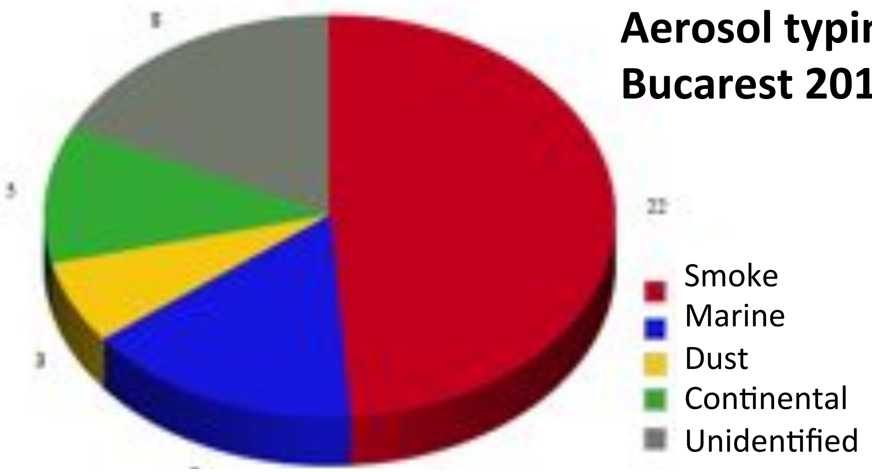
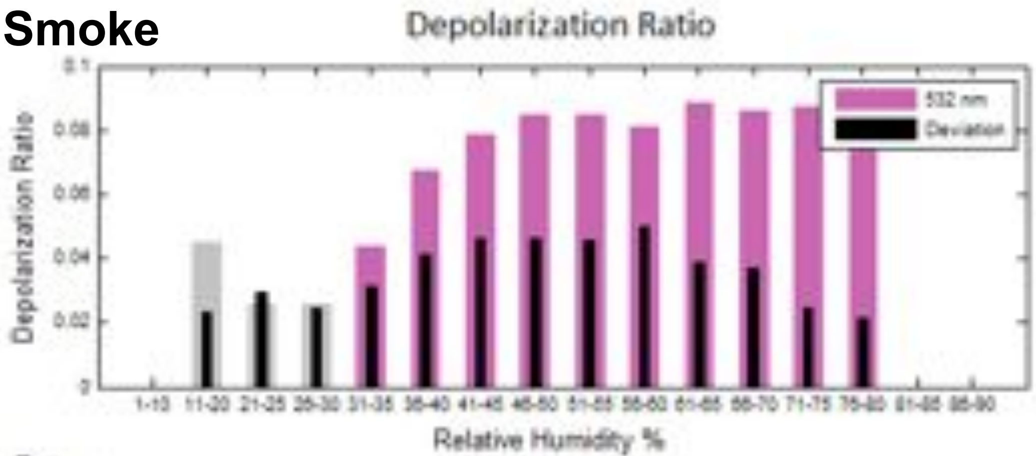
Aerosol typing: Bucarest 2013-2014



Smoke



Lev Labzovsky, INOE

Modification of aerosol optical properties due to humidity using **lidar** and **microwave radiometer**

Aerosol: Boundary layer height

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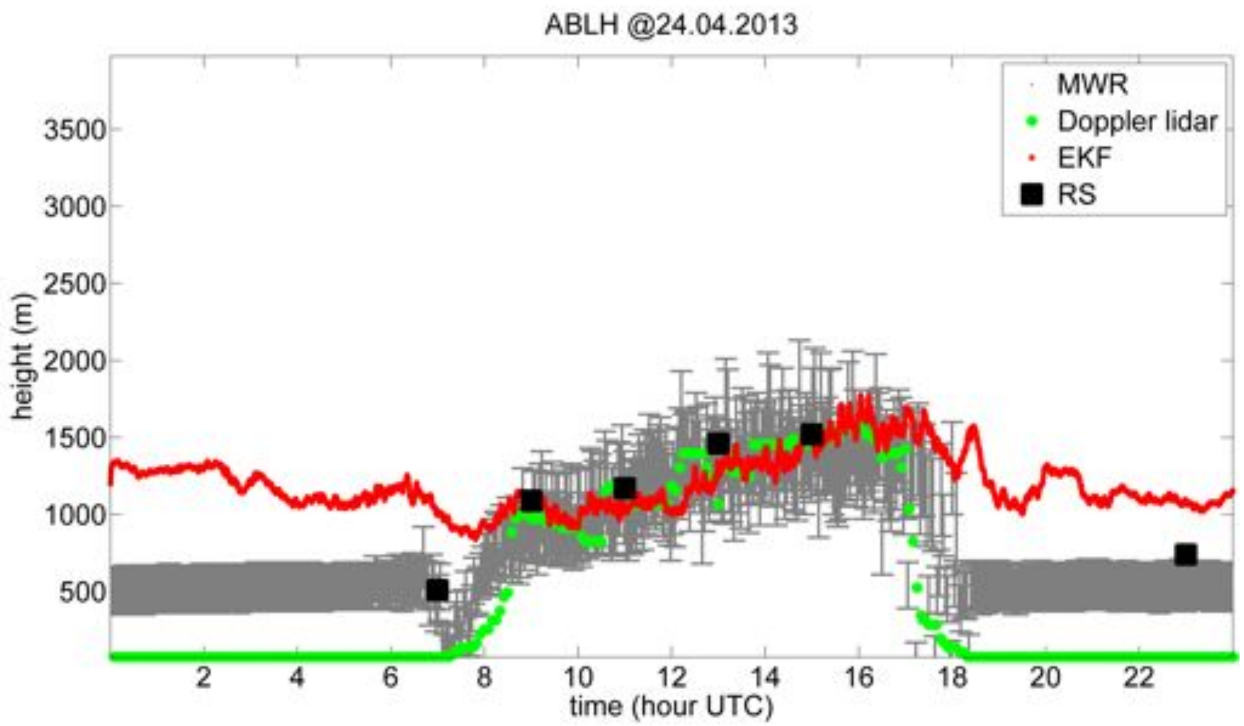

Umar Saeed, UPC

Atmospheric-Boundary-Layer Height Retrieval using **Microwave Radiometer** and **Lidar** Sensors: Algorithms and error Estimation

EKF – Extended Kalman Filter using lidar
RS – radiosounding

Aersol size

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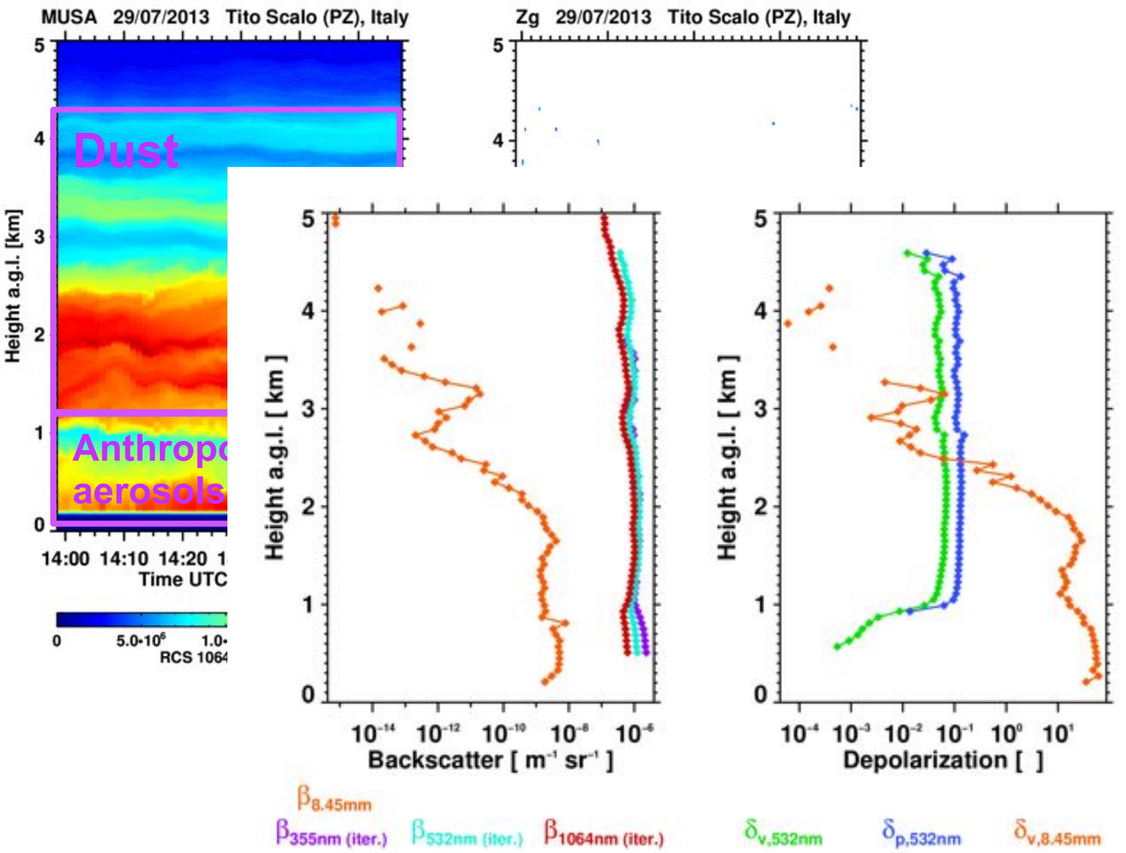
Lidar **Cloud radar**



Backscatter **Depolarization**

Pilar Gumà Claramunt; CNR-IMAA

Synergy between **Doppler radar and Raman lidar** for aerosol investigation

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Aerosol shape-size distribution

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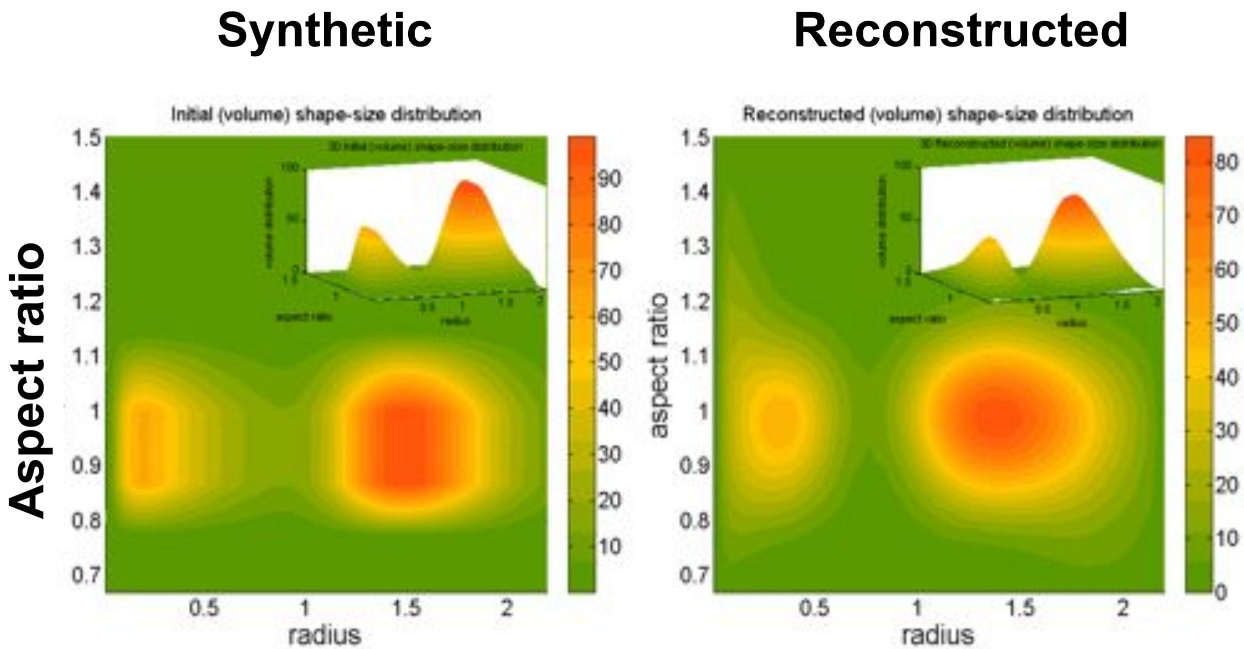

Stefanos Samaras
UPotsdam

- construction of synthetic distribution (bimodal lognormal with mixture of sphere-spheroid particles
- synthetic multiwavelength, depol lidar + noise
- minimization using the Padé iterative regularization

Microphysical **retrieval** of aerosol parameters using multi-wavelength lidar and depolarization signals

Dust model evaluation

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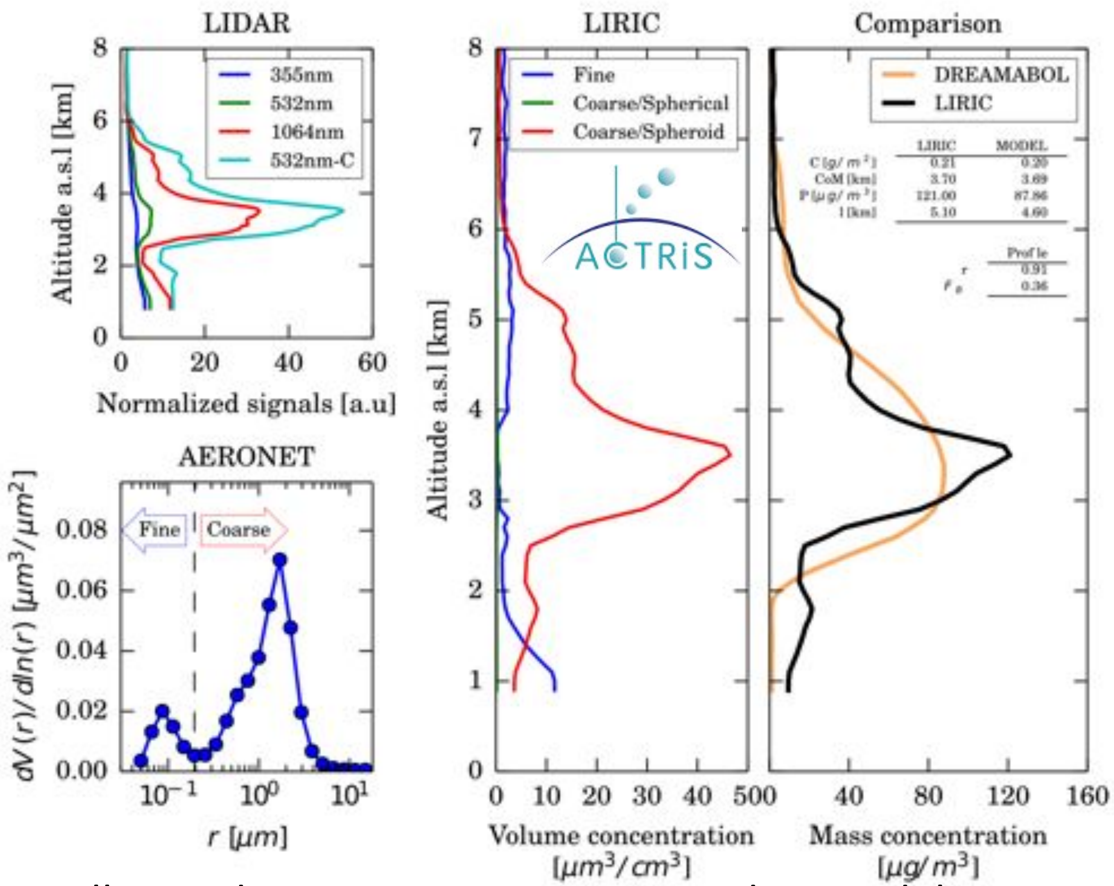

55 collocated measurements compared to models contributing WMO's Sand and Dust storm Warning and Advisory System

Dr. Ioannis Binietoglou, INOE

Influence of **long-range transported aerosols** on air quality from in situ and remote sensing data

Scientific Results

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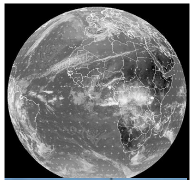
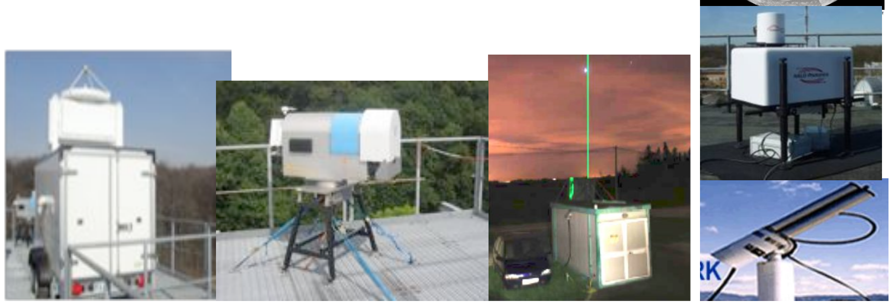
- Sophia Schäfer (UReading)
- Lukas Pfitzenmaier (TU Delft)
- Alexander Myagkov (TROPOS)
- Dr. Eduard Martins (TU Delft)

Clouds

+ Satellite, Doppler Lidar





- clouds & radiation
- cloud effects on energy budget
- mixed-phase clouds
- ice particle shape

3D Cloud Effects

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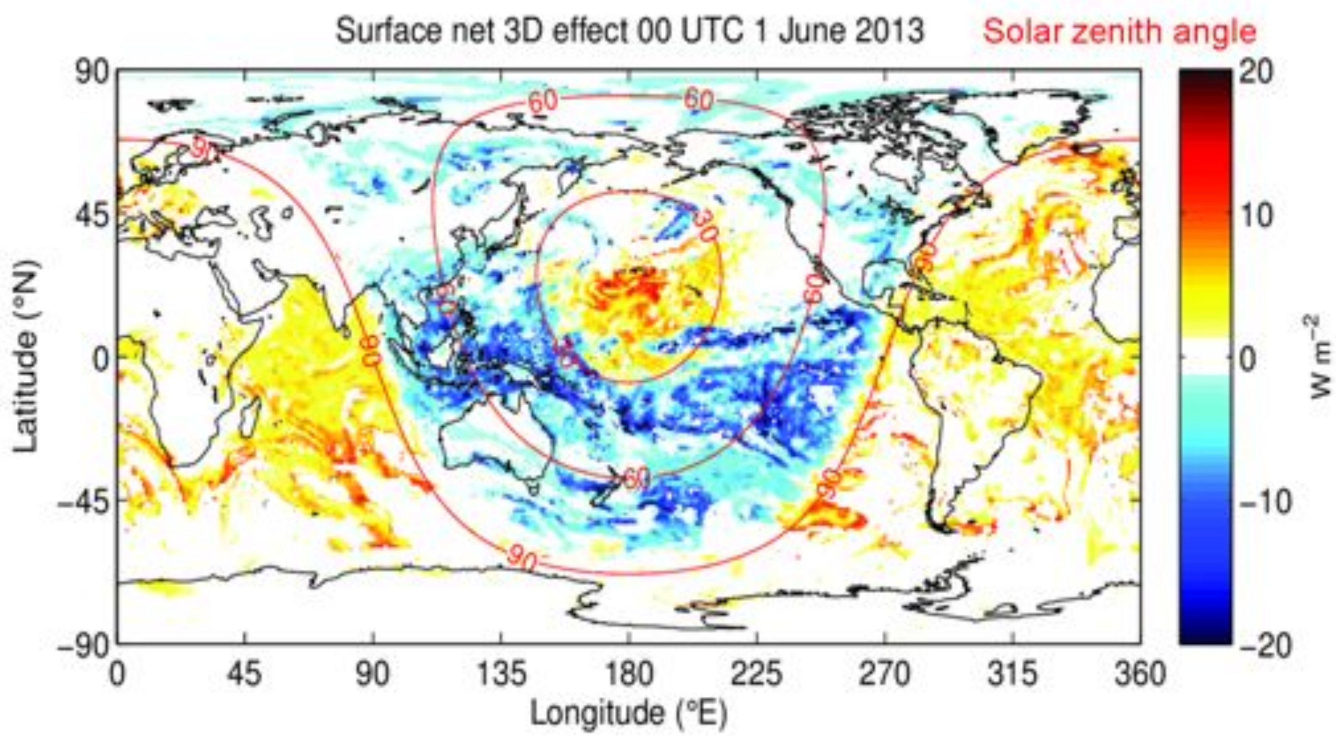

Sophia Schäfer, UReading

longwave 3D effect always increases cloud radiative forcing, during day-time, shortwave effects dominate

➔ cloud radar observations for cloud edge length needed as input for parametrizations

Cloud-radiation parameterisations based on 3D radiative transfer and sensor synergy

Cloud radar + lidar

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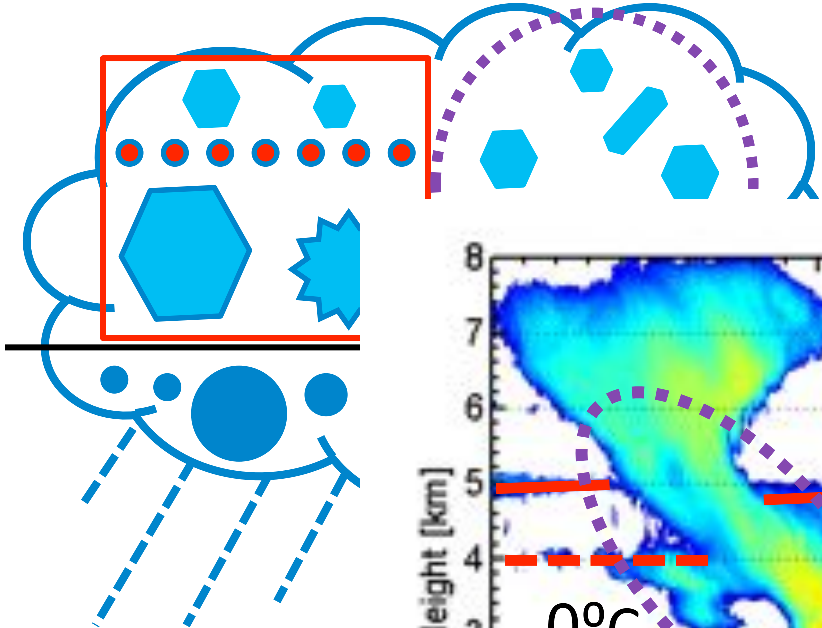
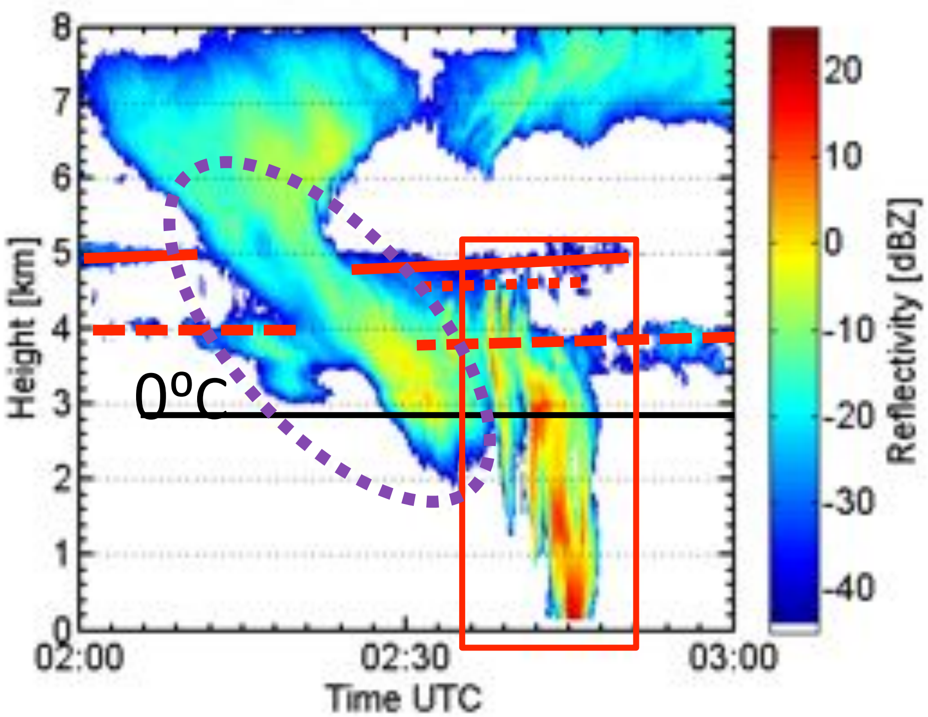
Ice crystal growth with liquid

Ice crystal growth without liquid



Understand the effect of super-cooled liquid droplets on ice crystals growth



Lukas Pfitzenmaier
TU Delft

Observation of crystal habits and sizes in **ice / mixed phase clouds**

Cloud radar: Polarizability

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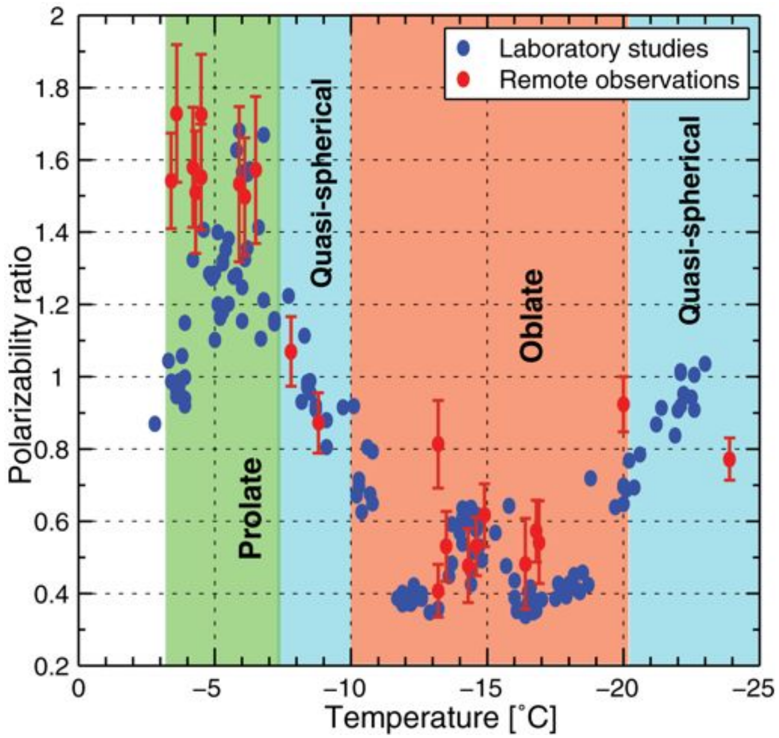
Polarizability ratio is a function of geometrical axis ratio of an ice crystal and its apparent ice density



ACCEPT (Analysis of the Composition of mixed-phase Clouds with Extended Polarization Techniques) campaign
Cabauw, the Netherlands, Oct-Nov 2014

Alexander Myagkov, TROPOS

Investigation of **ice formation** in mixed-phase clouds based on combined radar and lidar observations

Scientific Results

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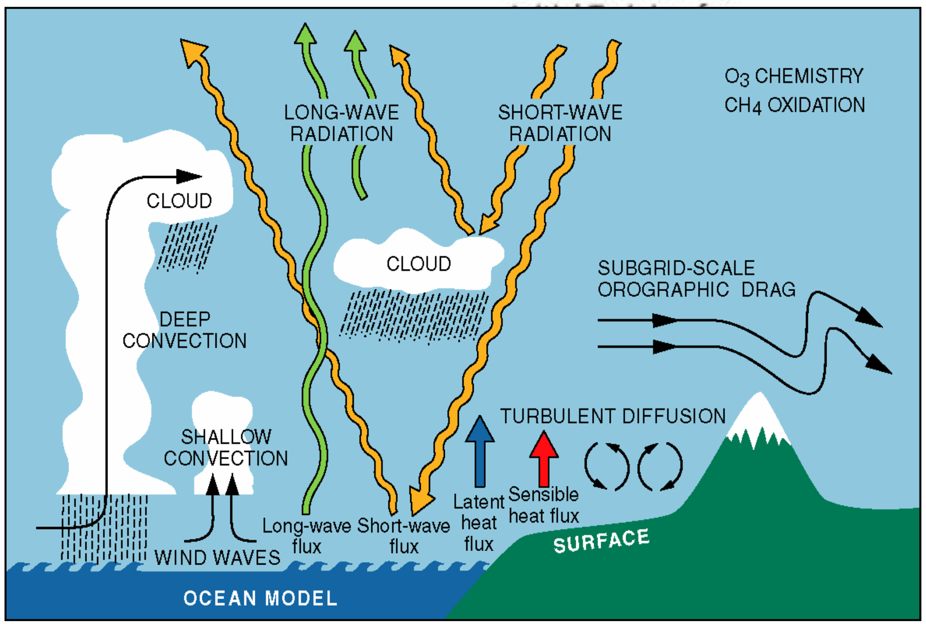
- Claudia Aqcuitapace
- Maria Barrera
- Athina Argyrouli
- Robert Banks
- Dr. Nicolae Ajtai
- Dr. XinXin Li
- Dr. Jordi Tiana-Alsina

Climate & Weather



- water vapor
- aerosol activation
- cloud-aerosol interaction
- precipitation formation
- air pollution

Thermodynamic profiling

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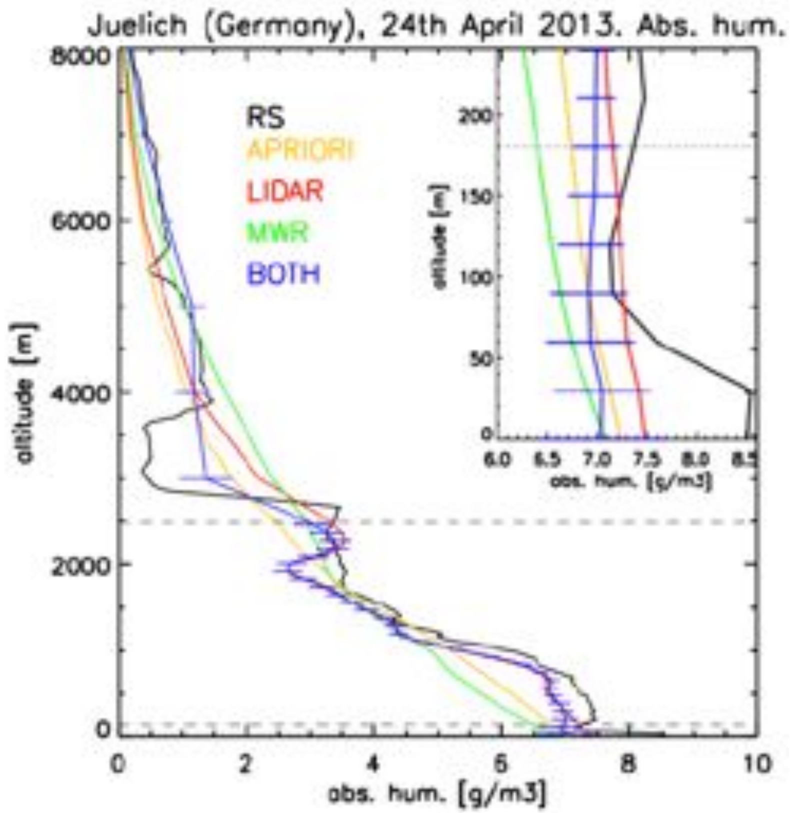
Optimal estimation of temperature and humidity profiles including error estimates from multispectral microwave and lidar measurements



Maria Barrera Verdejo, UCologne

Synergy of **Raman lidar** and **microwave radiometry** for high vertically resolved temperature and water vapor profiles

Doppler radar spectra

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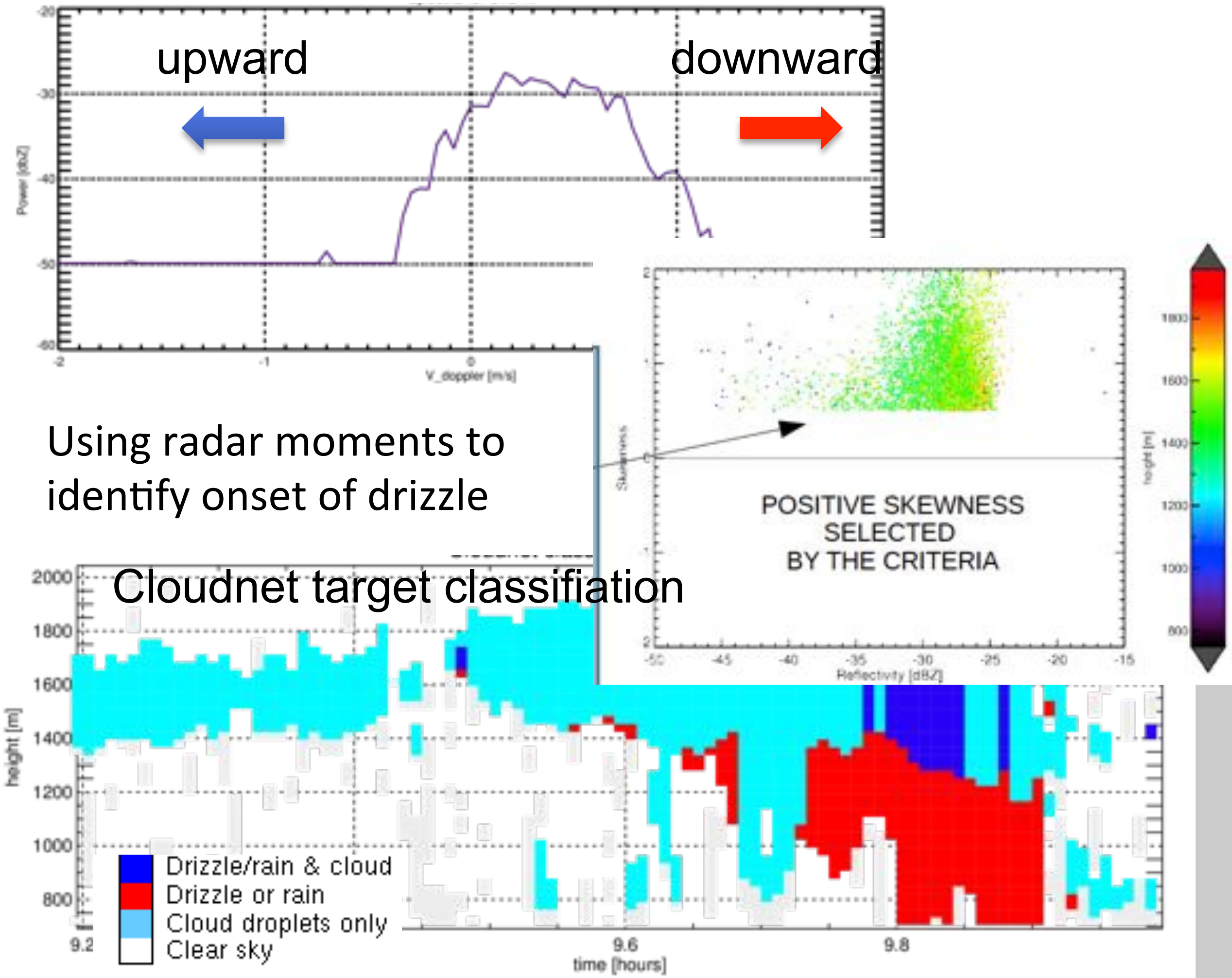

Claudia Acquistapace, UCologne

Detection of **autoconversion processes** in clouds using ground-based passive and active microwave sensors

Doppler radar spectra

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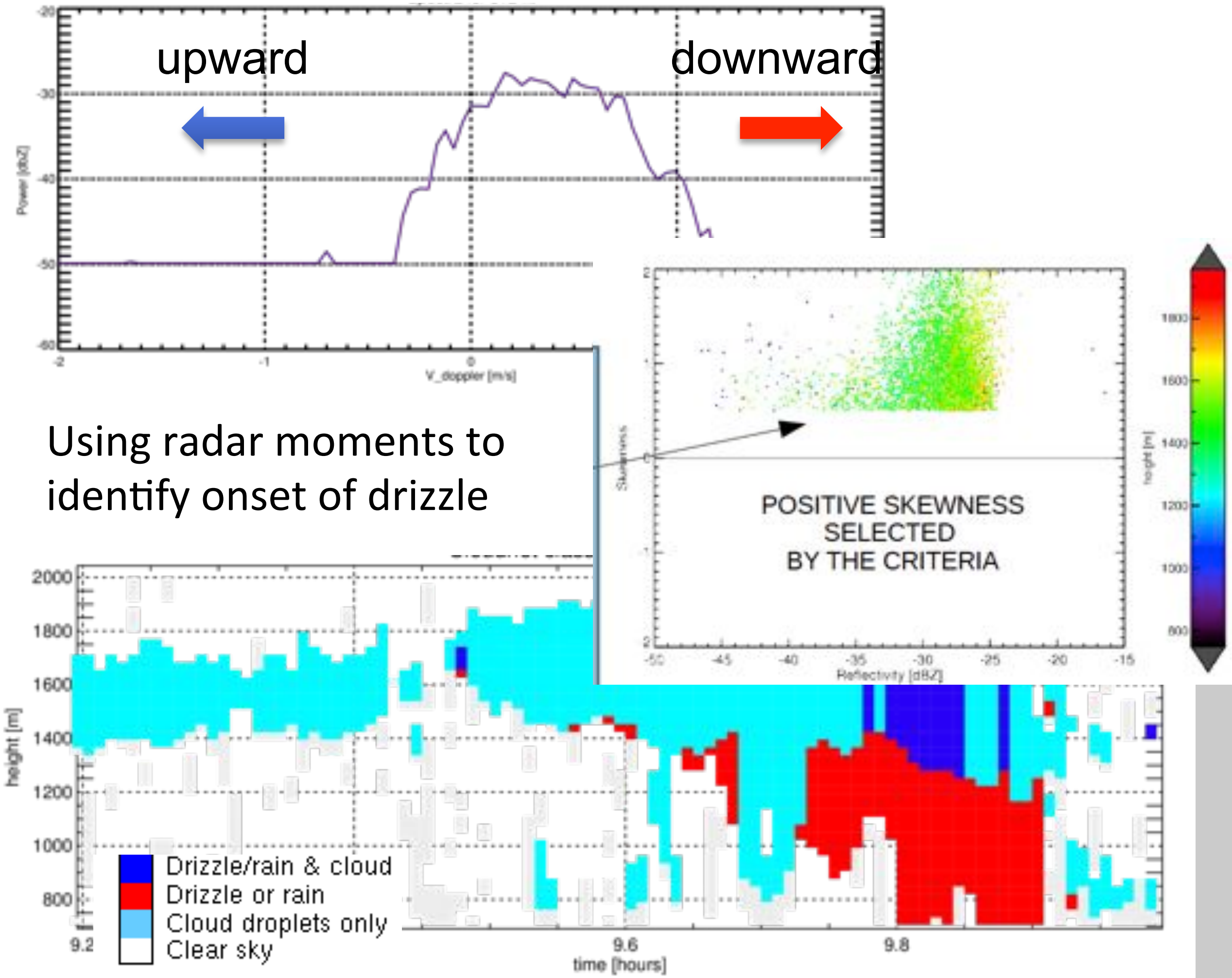

Using radar moments to identify onset of drizzle

Claudia Acquistapace, UCologne

Detection of **autoconversion processes** in clouds using ground-based passive and active microwave sensors

Boundary layer development

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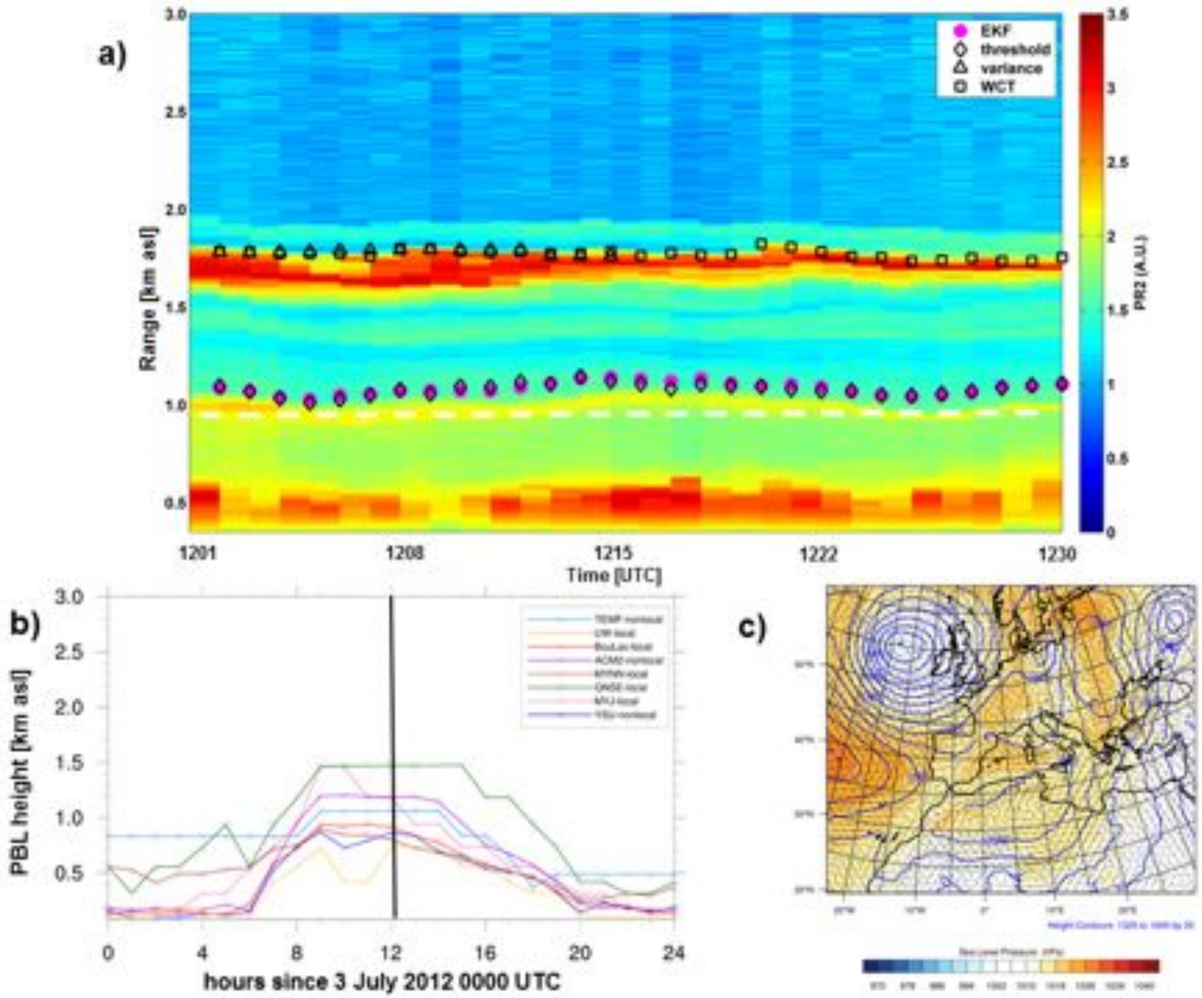

Robert Banks, UPC

Assessment of planetary boundary-layer schemes with advanced **remote sensing** instruments and **air quality modelling**

Aerosol vertical development

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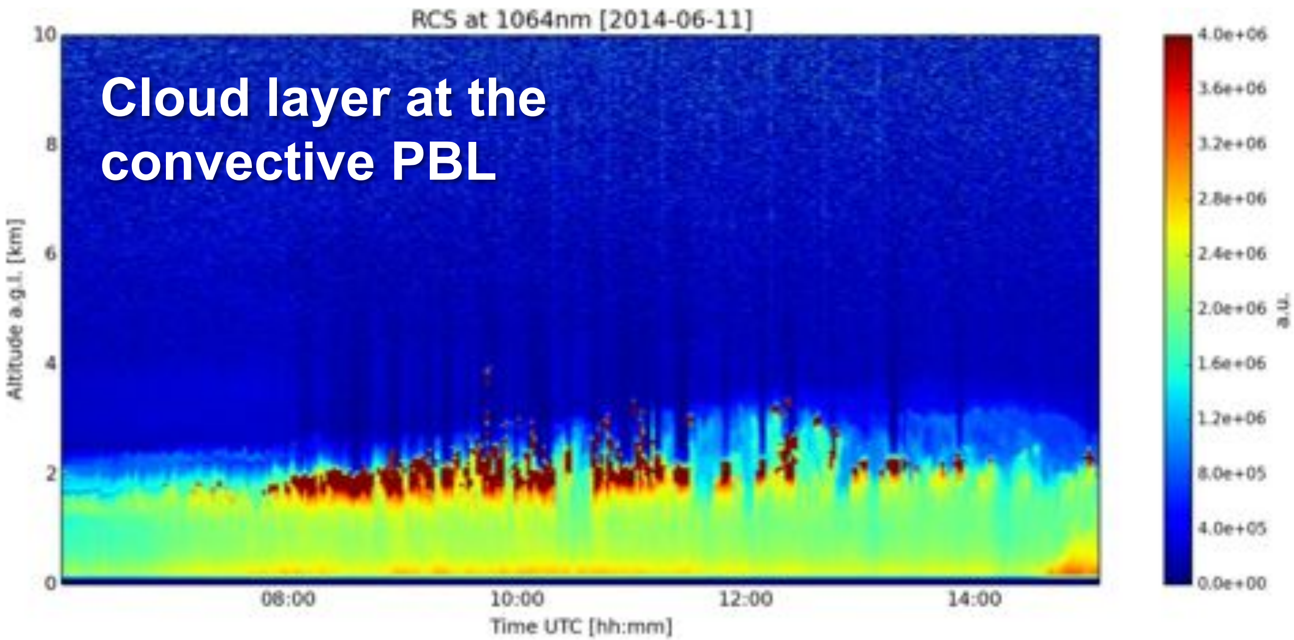

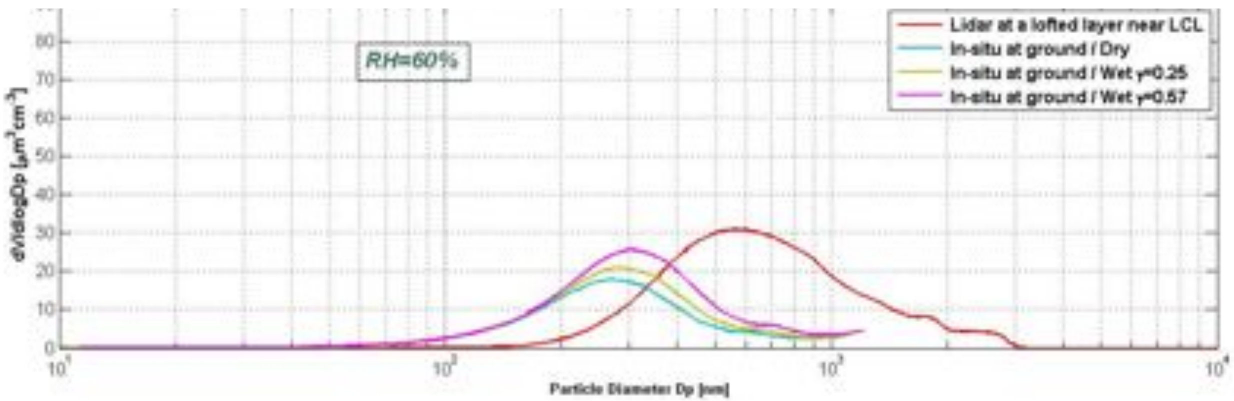

Athina Argyrouli, NTUA

Study of the **planetary boundary layer** and its influence on cloud properties

Lidar + Microwave Radiometry

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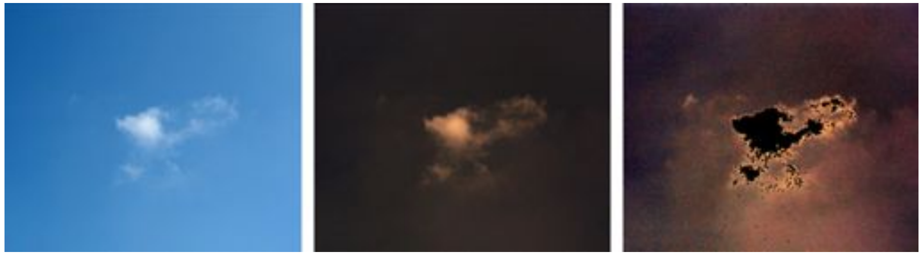
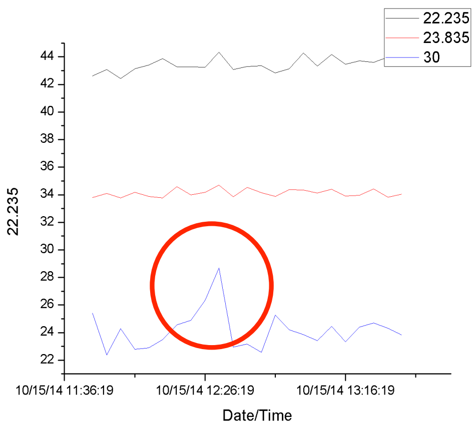
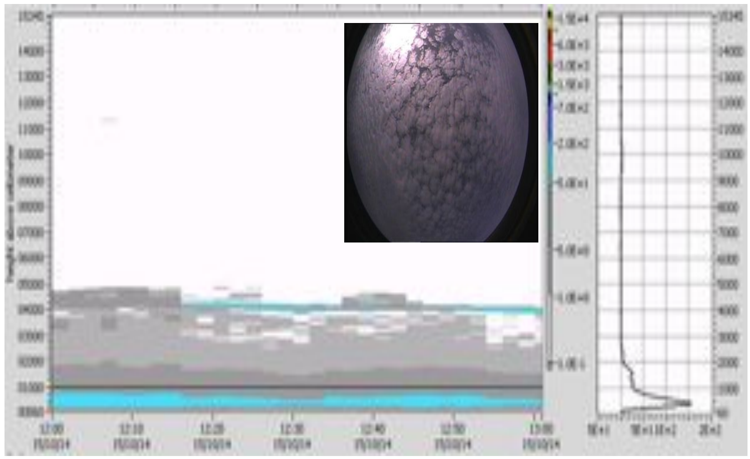


Koren et al., 2007

- liquid water signatures in broken cloud and cloud-free datasets
- increase in brightness temperature (Tb) in the 30 GHz channel of the MWR with respect to the channels around 22-23 GHz





Dr. Nicolae Ajtai, CNR-IMAA

Investigation of the "**twilight zone**" between aerosols and clouds

Aerosol Cloud Interaction

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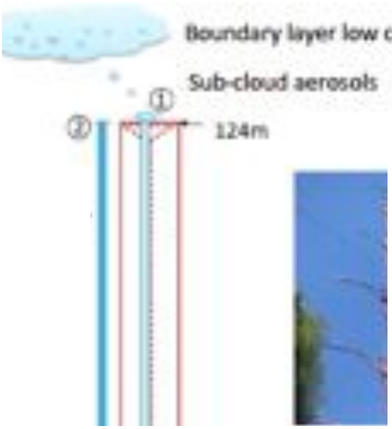
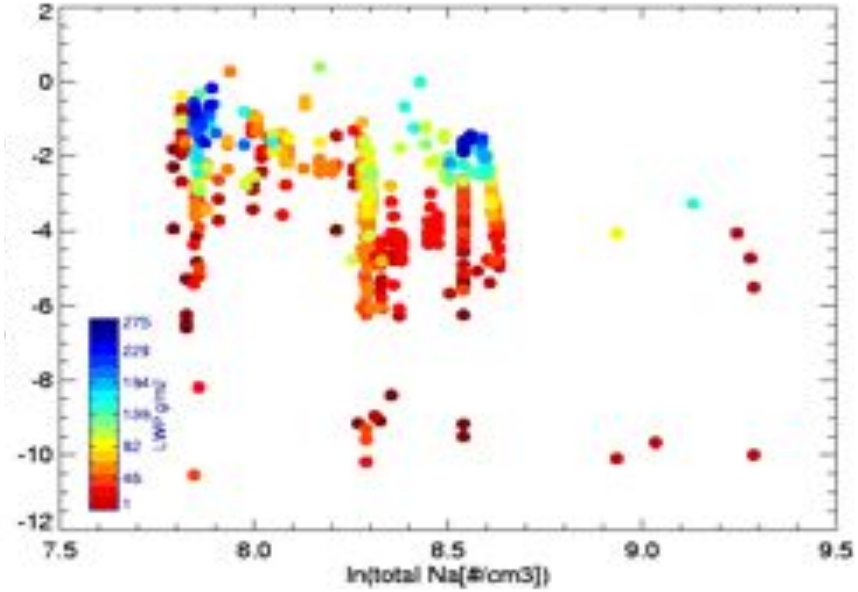


Increasing aerosol load leads to increased cloud droplet concentration and decreased effective radius at constant liquid water path (LWP)



Radar integrated reflectivity as proxy for cloud droplet size

Total aerosol number concentration

Dr. Xinxin Busch Li, UCologne

Statistical assessment of **aerosol influence on** cloud properties

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Thanks for your attention and looking forward to seeing you at booth 3150